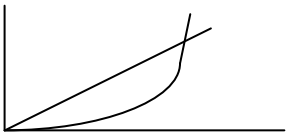


## 4728 Mechanics 1

<b>1 i</b>	$v = 4.2 + 9.8 \times 1.5$ $v = 18.9 \text{ ms}^{-1}$ .	M1 A1 [2]	Uses $v = u + gt$ 18.9(15) from $g = 9.81$
<b>ii</b>	$s = 4.2 \times 1.5 + 9.8 \times 1.5^2/2$ or $18.9^2 = 4.2^2 + 2 \times 9.8s$ $s = 17.325 \text{ m}$	M1 A1 [2]	Uses $s = ut + gt^2/2$ or $v^2 = u^2 + 2gs$ Accept 17.3
<b>iii</b>	$v^2 = 4.2^2 + 2 \times 9.8 \times (17.3(25) - 5)$ $v = 16.1 \text{ ms}^{-1}$	M1 A1 [2]	$18.9^2 = u^2 + 2 \times 9.8 \times 5$ $u = 16.1 \text{ ms}^{-1}$ . Accept answers close to 16.1 from correct working
<b>2 i</b>	Resolves a force in 2 perpendicular directions Uses Pythagoras $R^2 = (12+19\cos60)^2 + (19\sin60)^2$ $R = 27.1 \text{ N}$ { $R = \sqrt{(19+12\cos60)^2 + (12\sin60)^2} = 27.1$ }	M1 DM1 A1 A1 A1 [5]	<i>Diagram for vector addition/subtraction</i>  <i>Uses Cosine Rule</i> $R^2 = 12^2 + 19^2 - 2 \times 12 \times 19\cos120$ $R = 27.1$
<b>ii</b>	Trig on a valid triangle for correct angle $\tan\theta = (19\sin60)/(12 + 19\cos60)$ etc Angle is $37.4^\circ, 37.5^\circ$	M1 A1 A1 [3]	Either Pythagoras or vector add/sub triangle $\sin\theta/19 = \sin120/(27.1)$ etc
<b>3ia</b>	$+/- (9m + 2 \times 0.8)$ { $+/- (3.5 \times 0.8 - 2 \times 0.8)$ } $+/- (-3.5m + 3.5 \times 0.8)$ { $+/- (9m + 3.5m)$ } $+/- (9m + 2 \times 0.8) = +/- (-3.5m + 3.5 \times 0.8)$ $m = 0.096 \text{ kg}$	B1 B1 M1 A1 [4]	Before mom, or mom change Q, OK with g After mom, or mom change P, OK with g Equates moms, or changes, accept with g Do not award if g used
<b>ib</b>	$+/- 0.096(9 +/- 3.5)$ OR $+/- 0.8(3.5 - 2)$ $+/- 1.2 \text{ kgms}^{-1}$	M1 A1ft [2]	Using before & after speeds of P or Q, no g ft $12.5 \times cv(0.096)$
<b>ii</b>	$(0.8+0.4)v$ or $0.8v + 0.4v$ $3.5 \times 0.8 + 0.4 \times 2.75 = (0.8+0.4)v$ $v = 3.25 \text{ ms}^{-1}$	M1 A1 A1 [3]	Using Q and R common speed after, no g $2.8 + 1.1 = 1.2v$
<b>4ia</b>	$0.3g\cos 60$ and $0.3g\sin60$ $0.4g\cos60$ and $0.4g\sin60$ Calculates either relevant difference Perp = $0.1g\cos60$ and Para = $+/- 0.1g\sin60$	B1 B1 M1 A1 [4]	Accept use of "m = 0.1 kg" for M1 and $0.1g\cos60$ (B1) $0.1g\sin60$ (B1) $= 0.49$ and $= 0.849$ (accept 0.85 and 0.84)
<b>ib</b>	$0.1g\sin60 = \mu 0.1g\cos60$ $= 1.73 (= \sqrt{3})$	M1 A1 [2]	$F = \mu R, F > R > 0$ From correct R, F values

4 ii	$0.5g - T = 0.5a$ $T - 0.4g = 0.4a$ $a = 1.09 \text{ ms}^{-2}$ $T = 4.36 \text{ N}$	M1  A1 B1 B1 [4]	N2L for either particle no resolving, at least 1 unknown Formula round the pulley, M0A0. But award M1 for $T - 0.4g = 0.4 \times 1.09$ etc later Both equations correct
5 i	$11 = 3 + 20a$ (a = 0.4) $8 = 3 + (11-3)t/20$ $t = 12.5$	M1 M1 A1 [3]	Uses $v = u + at$ , no zero terms Their $a > 0$ . $t/20 = (8-3)/(11-3)$ is M1M1
ii	$s(A,20) = 8 \times 20 (=160)$ $s(B,20) = (3 + 11) \times 20/2 =$ $3 \times 20 + 0.4 \times 20^2/2 (=140)$ $8T = (3+11) \times 20/2 + 11 \times (T-20)$ or $(160 - 140) = 11t - 8t$ $T = 26 \frac{2}{3}$	B1  B1 M1 A1 A1 [5]	Or $s(A) = 8T$  or as stage of $s(B) = (3+11) \times 20/2 + 11 \times (T-20)$ 3 part equation balancing distances  Accept 26.6 or 26.7
iii		B1  B1  B1 [3]	Linear rising graph (for A) starting at B's start Non-linear rising graph for B below A's initially. Accept 2 straight lines as non-linear. Single valued graphs graphs intersect and continue
6 i	$a = 2 \times 0.006t - 0.18$ $a = 0.012t - 0.18$	M1 A1 [2]	Differentiates $v$ (not $v/t$ ) Award for unsimplified form, accept $+c$ , not $+k$
ii	$0.012t - 0.18 = 0$ $t = 15$  $0.006 \times 15^2 - 0.18 \times 15 + k = 0.65$ $k = 2$	M1* A1 D*M1 A1 A1 AG [5]	Sets $a = 0$ , and solves for $t$  Substitutes $t(v(\min))$ in $v(t)$
iii	$s = 0.006t^3/3 - 0.18t^2/2 + 2t (+c)$ $(s = 0.002t^3 - 0.09t^2 + 2t (+c))$ $t = 0, s = 0$ hence $c = 0$ $L = 0.002 \times 28.4^3 - 0.09 \times 28.4^2 + 2 \times 28.4$ $L = 30.0 \text{ m}$	M1A1  B1 M1 A1 [5]	Integrates $v$ (not multiplies by $t$ ). Award if $+c$ omitted, accept $kt$ Explicit, not implied (or uses limits 0, 28.4) Substitutes 28.4 or 14.2 in $s(t)$ , (and $k=2$ ) Accept a r t 30(.0), accept $+c$

7 i	$(Fr =) 0.15 \times 600g\cos 10$ $(Wt \text{ cmpt} =) 600g\sin 10$ $600 \times 0.11 = T - 0.15 \times 600g\cos 10 - 600g\sin 10$ $(66 = T - 868.6 - 1021)$ $T = 1960 \text{ N}$	B1 B1 M1 A1 A1 [5]	Implied by $Fr = 0.15 \times 600g\cos 10 (=868.6..)$ N2L. T with at least 1 resolved forces and $600 \times 0.11$ 1955.6..
ii a	$a(\text{up}) = +/- (600g\sin 10 + 0.15 \times 600g\cos 10) / 600$ $a(\text{up}) = +/- 3.15 \text{ ms}^{-2}$ AG	M1 A1 [2]	2 resolved forces and 600a or "unit mass" Disregard sign, accept 3.149
b	UP $v^2 = 2 \times 0.11 \times 10$ $v = 1.48$ when cable breaks $t = 1.48 / 3.149$ $(t = 0.471 \text{ time for log to come to rest})$ $s = 1.48^2 / (2 \times 3.149)$ $s = 0.349$ distance for log to come to rest DOWN $a(\text{down}) = (600g\sin 10 - 0.15 \times 600g\cos 10) / 600$ $10 + 0.349 = 0.254t^2 / 2$ $t = 9.025$ $T = (9.025 + 0.471) = 9.5 \text{ s}$	M1 A1 M1 M1 A1 B1 M1 A1 A1 [9]	Correct, need not be accurate Or $1.48 = 0 + 3.15t$ Correct, need not be accurate = 0.254 Needs $a < 3.15, s > 10$ . Or $V^2 = 2 \times 0.254 \times (10 + 0.349)$ [ $V = 2.29..$ ], $V = 0.254t$ Correct, need not be accurate Accept 9.49